

AD_____

Award Number: DAMD17-94-J-4508

TITLE: California Cancer Registry Enhancement for Breast
Cancer Research

PRINCIPAL INVESTIGATOR: William Wright, Ph.D.

CONTRACTING ORGANIZATION: Public Health Institute
Berkeley, California 94704

REPORT DATE: July 1999

TYPE OF REPORT: Final

PREPARED FOR: U.S. Army Medical Research and Materiel Command
Fort Detrick, Maryland 21702-5012

DISTRIBUTION STATEMENT: Approved for Public Release;
Distribution Unlimited

The views, opinions and/or findings contained in this report are
those of the author(s) and should not be construed as an
official Department of the Army position, policy or decision
unless so designated by other documentation.

20000303 085

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY <i>(Leave blank)</i>		2. REPORT DATE July 1999	3. REPORT TYPE AND DATES COVERED Final (1 Oct 94 - 30 Jun 99)
4. TITLE AND SUBTITLE California Cancer Registry Enhancement for Breast Cancer Research		5. FUNDING NUMBERS DAMD17-94-J-4508	
6. AUTHOR(S) William Wright, Ph.D.			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Public Health Institute Berkeley, California 94704		8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army Medical Research and Materiel Command Fort Detrick, Maryland 21702-5014		10. SPONSORING / MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES			
12a. DISTRIBUTION / AVAILABILITY STATEMENT		12b. DISTRIBUTION CODE	
13. ABSTRACT <i>(Maximum 200 words)</i> The purpose of this project was to enhance the value of the California Cancer Registry (CCR) as a research tool for clinicians and epidemiologists interested in conducting breast cancer research. The objectives of the project were to: (1) classify breast cancers according to the major staging schemes currently in use in the U.S.; (2) increase the amount of treatment data for breast cancer; and (3) link breast cancer case date with other data bases to improve survival information and collect co-morbidity and insurance status information. These objectives were accomplished and the CCR is now actively pursuing a broader scope of research than had been previously possible. However, breast cancer first course of treatment data was demonstrated to be under-reported, and follow-up to retrieve it was labor intensive and not universally successful. Studies with those data continue to be severely constrained.			
14. SUBJECT TERMS Breast Cancer, Cancer Registries		15. NUMBER OF PAGES 38	
		16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT Unlimited

FOREWORD

Opinions, interpretations, conclusions and recommendations are those of the author and are not necessarily endorsed by the U.S. Army.

Where copyrighted material is quoted, permission has been obtained to use such material.

Where material from documents designated for limited distribution is quoted, permission has been obtained to use the material.

Citations of commercial organizations and trade names in this report do not constitute an official Department of Army endorsement or approval of the products or services of these organizations.

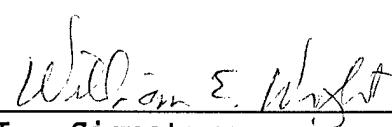
In conducting research using animals, the investigator(s) adhered to the "Guide for the Care and Use of Laboratory Animals," prepared by the Committee on Care and use of Laboratory Animals of the Institute of Laboratory Resources, national Research Council (NIH Publication No. 86-23, Revised 1985).

For the protection of human subjects, the investigator(s) adhered to policies of applicable Federal Law 45 CFR 46.

In conducting research utilizing recombinant DNA technology, the investigator(s) adhered to current guidelines promulgated by the National Institutes of Health.

In the conduct of research utilizing recombinant DNA, the investigator(s) adhered to the NIH Guidelines for Research Involving Recombinant DNA Molecules.

In the conduct of research involving hazardous organisms, the investigator(s) adhered to the CDC-NIH Guide for Biosafety in Microbiological and Biomedical Laboratories.


William E. Wright
PI - Signature

8/2/88
Date

TABLE OF CONTENTS

	<u>Page</u>
Front Cover	1
Report Documentation Page.....	2
Foreword.....	3
Introduction	5
Body	5
Key Research Accomplishments	9
Reportable Outcomes	10
Conclusions	11
References	11
List of Persons Receiving Pay from this Research Effort ...	13
Appendices	
I. Journal Article	14

INTRODUCTION

The purpose of this project was to enhance the value of the California Cancer Registry (CCR) as a research tool for clinicians and epidemiologists interested in conducting breast cancer research. The goals were to code in greater detail the extent of disease at the time of diagnosis, to gather complete information about the first course of treatment, to collect follow-up information about vital status, to code information about occupation and industry, to link the CCR files with a variety of existing files containing information on patterns and costs of care, and to develop mechanisms by which a wide audience of breast cancer researchers can obtain access to the CCR database.

BODY

Task 1 - Code SEER Extent of Disease for all breast cancers diagnosed in California starting with January 1, 1988.

Between 1988 and 1993 all breast cancers were staged according to the National Cancer Institute's (NCI) Surveillance, Epidemiology, and End Results (SEER) Program Summary Staging Guide (1), basically a classification of cases into *in situ*, localized, regional, and distant disease. In 1994 the CCR changed its reporting requirement from the SEER Summary Stage to the SEER Program's Extent of Disease (EOD) (2) classification scheme in order to be able to apply a computer program available from the NCI to classify breast cancer cases into the TNM classifications and the Staging Categories (0, I, II, III, IV) of the American Joint Committee on Cancer (AJCC) (3). A major objective of this award was to reclassify all breast cancer cases diagnosed between 1988-1993 according to the SEER EOD classification scheme.

Task 1 was completed in Year 03 of the project, and the results were presented at the Department of Defense Breast Cancer Research Program Meeting in 1997 (see Year 03 Annual Report, Appendix V). With the addition of EOD coding to the CCR breast cancer records, scientists are now able to choose to study stage at diagnosis that closely resembles categories used by most oncologists. An example is a recent manuscript by the principal investigator (Wright) and colleagues which describes the increasing trend in use of breast-conserving surgery in California (Appendix I).

Task 2 - Collect complete first course of treatment information for all breast cancers diagnosed from 1993 through 1997.

Until recently, most population-based registries outside the SEER Program have been incidence only registries and have not been concerned with the collection of treatment data. Since its inception, the CCR has collected information on the first course of cancer treatment as recorded in the medical record at the time it is abstracted. Unfortunately, the data are known to be incomplete, especially for those cancer sites such as breast cancer which may be treated with a first course of chemotherapy and eventually followed up with radiation therapy. Chemotherapy and radiation therapy are primarily given outside the acute care hospital setting, and hospital medical records often lack the details of the complete first course of therapy that was given.

Data on female breast cancers come to the CCR from multiple sources. Frequently a patient is treated at more than one hospital, and additional treatment information may be received from a physician's office. When a new patient record is received from a hospital by a regional registry, it is either entered as a new case or "consolidated" with the records from other facilities into a single record. Hospitals frequently abstract and report a case shortly after it is diagnosed and treated in that facility. Subsequently, the hospital registrar may learn of additional treatment and update the hospital record. The updated information is then transmitted to the regional registry as an "update/correction record."

During Year 02 the CCR developed specifications for comparing correction record data with the main data base, and developed decision rules for handling discrepancies in order to automate as much of the process as possible. In Year 03 computer software for processing update/correction records was written, tested, and installed in the four different software systems used by the ten regional registries, and the backlog of breast cancer update/correction records was processed. (All of the specification and software development was funded with California breast cancer tobacco tax funds that were available to the CCR.)

During Year 03 methods for comparing treatment information contained in the registry file with the standard/recommended/state-of-the-art treatment for each stage and type of breast cancer described in the NCI's Physician Data Query (PDQ) (http://cancernet.nci.nih.gov/clinpdq/soa/Breast_cancer_Physician.html) and, if different, conducting follow back to query physicians' offices were developed. The Breast Cancer Treatment Follow Back Protocol consisted of: (1) comparing recommended breast cancer treatment with treatment recorded in the registry record; (2) computer programs to perform the comparison; (3) criteria for excluding cases from follow back; (4) updating physician addresses; (5) computer programs to generate customized letters to physicians requesting information on specific treatment that was recommended but not recorded in the registry record; (6) interaction with hospital cancer registry staff in order to determine who should perform the follow back, i.e. central registry or hospital registry staff; (7) criteria for intensity of follow back, i.e. multiple query letters and/or actual visits by program staff to physician offices to extract information from medical records; and (8) data entry onto update/correction records for processing to update registry data files.

During the pilot test of our methods for treatment follow-back (see Year 04 Annual Report, Appendix I) we determined that this task would require considerably more staff resources than we had first estimated due to the unanticipated necessity for multiple attempts to contact the physician of record, tracing physicians who had moved, interacting with hospitals for coordinating follow back activities that they may be engaged in, and in many cases having to physically go to physician offices to abstract treatment information from their files. Consequently, our Scope of Work was modified to collect first course of treatment information for all breast cancer cases statewide diagnosed only for the time period 1995 through 1996. During years 04 and 05 (no-cost extension) that work was completed.

Table 1 presents the results of the breast cancer first course of treatment follow-back. During 1995-1996 there were 46,612 breast cancer cases diagnosed in California. Of these, 34.5% were

Table 1. 1995/1996 Breast Cancer Treatment Follow-Back Report

Total number of invasive & <i>in situ</i> breast cancer cases	46,612
Cases with complete treatment, no follow-back needed	16,075 (34.5%)
Number of cases for follow-back	30,537
<u>Reasons for Excluding Cases from Follow-Back:</u>	
Surgery not recommended	363
Other treatment not recommended	408
Non-resident	2,435
Death Clearance Only	80
MD Only	652
Patient refused treatment	287
No MD available	719
Patient expired	205
MD out-of-region	1,921
Other	<u>3,180</u>
Total number excluded	10,250 (33.6%)
<u>Follow-Back</u>	
Number of cases mailed to physicians	20,287
Number of responses	12,741
Response Rate	62.8%
<u>Yield</u>	
Number of cases with additional treatment	5,175 (40.6%)
Number with additional surgery	92 (1.8%)
Number with additional radiation	1,235 (23.9%)
Number with additional chemotherapy	1,061 (20.5%)
Number with additional hormone therapy	3,220 (62.2%)
Cases with complete treatment after follow-back	19,787 (42.5%)
<u>Effort</u>	
FTE/1,000 breast cancer cases	0.13 FTE

recorded as having received PDQ recommended treatment. Just under 34 percent of the remaining cases were excluded from follow-back for a variety of reasons. Follow-back letters were mailed for 20,287 cases and, after multiple mailings, phone calls, and in some cases physician office visits, the final response rate was 62.8 percent. Among the 12,741 cases with a physician response, 7,034 cases were reported to be complete. Of the 5,175 cases for which additional treatment information was obtained, hormone therapy was the most frequently reported additional information. Overall the follow-back yield resulted in an increase in the percent of breast cancer cases recorded as having received PDQ recommended therapy from 34.6 to 42.5 percent. This increase in information required an estimated 0.13 annual FTE per 1,000 breast cancer cases.

Task 3 - Collect patient follow-up information on all breast cancers diagnosed from 1988 forward by linking the CCR files with Department of Motor Vehicles and voter registration files.

The results of our linkage with the Department of Motor Vehicles (DMV) files were described in the Year 02 annual report. In the poster session at the 1997 Department of Defense Breast Cancer Research Program Meeting, we reported that using DMV records we were able to update follow-up by nearly 20 percent (see Year 02 Annual Report, Appendix V). Because of the success of this linkage we have developed procedures to conduct annual linkages with DMV files for all not-known-dead cases in the CCR files. These linkages substantially improve our ability to perform survival analyses.

Linkage with voter registration files was not performed. This task would have required more resources than were available, and it was deleted during budget negotiations at the beginning of the grant.

Task 4 - Complete occupation/industry coding for all breast cancer cases from 1998 through 1997.

This objective was deleted during budget negotiations at the beginning of the grant.

Task 5 - Link CCR files with data from several large breast cancer screening programs to correlate screening status with subsequent diagnostic status.

As we reported in the Year 04 progress report, the CCR linked a file of women who had been screened for breast and cervical cancer by the California Breast and Cervical Cancer Control Program (BCCCP) (funded by the Centers for Disease Control (CDC)) with a CCR file of all female cancer cases diagnosed between 1988 and 1997. The linked file was given to BCCCP for analysis, and the Battelle Corporation, under contract from the CDC, reported the results in a evaluation study of the BCCCP (4).

The CCR, in collaboration with the California Breast Cancer Early Detection Program (BCEDP) (funded by the California Tobacco Tax Breast Cancer Fund), also linked a file of BCEDP clients who had been screened for breast cancer with a CCR file of all female cancer cases diagnosed between 1988 and 1997. The linked file was given to BCEDP for analysis.

The CCR also collaborated in a study of breast cancer among California's Medi-Cal (the California Medicaid program) population. The results of those analyses have been presented at three conferences (5,6,7), and a manuscript is being prepared for publication (see Year 04 Annual Report, Appendix III).

Task 6 - Link CCR files with hospital discharge and Medicare files to incorporate insurance status, expected hospital charges, and comorbidities into the CCR database.

Results of our linkages with the Health Care Financing Administration (HCFA) Medicare files were described in each of our annual reports, and we gave one presentation (see Year 02 Annual Report, Appendix II) and published a paper on the utility of using Medicare files for population-based cancer registry case ascertainment (8) (see Year 04 Annual Report, Appendix IV). Another manuscript using the results of the linkage was prepared by colleagues at California Medical Review, Inc. (see Year 02 Annual Report, Appendix III). The utility of hospital discharge data for follow-up purposes was described in our Year 02 annual report, and the utility of hospital discharge data linkages for garnering insurance and co-morbidity status was reported in our Year 04 annual report. These linkages are now part of the CCR routine processing. However, use of the enhanced CCR database requires extra care by researchers in order to understand the specifics and limitations of HCFA and hospital discharge data.

Task 7 - Design and produce a series of confidential and nonconfidential datasets with complete documentation and convenient access for researchers, and produce required reports for the USAMRDC.

Confidential and nonconfidential breast cancer datasets with SEER EOD coding, enhanced treatment, follow-up, and co-morbidity information are now available from the CCR to qualified researchers. With the submission of this Final Report, all required reports for the USAMRDC will have been produced.

KEY RESEARCH ACCOMPLISHMENTS

- ◆ Coded all breast cancers diagnosed in California from 1998 to 1993 according to SEER Extent of Disease criteria.
- ◆ Conducted follow-back to physician offices for first course of treatment information on breast cancers diagnosed in 1995-1996 where CCR records indicated treatment was less than that recommended by a national consensus panel. Determined that treatment data was under reported during those years.
- ◆ Developed and implemented methods to increase patient follow-up by linking with Department of Motor Vehicle files.
- ◆ Demonstrated the feasibility of using CCR records to assist in evaluating breast cancer screening programs.
- ◆ Demonstrated the feasibility and utility of linking CCR records with hospital discharge records and with HCFA files.

REPORTABLE OUTCOMES

Manuscripts:

Parker JD, Newman JN, Gebretsadik T, Kileen M. Managed Care and Treatment for Early Stage Breast Cancer: California Medicare, 1993. San Francisco, CA: California Medical Review, Inc., 1996.

Allen ME, Perkins CI, Wright WE. Using Medicare Administrative Files to Evaluate Case Ascertainment in a Central Cancer Registry. *J Reg Mgmt.* 1998; 25(1):13-16.

Morris CR, Cohen R, Schlag R, Wright WE. Increasing use of breast-conserving surgery in California. *Am J Public Health*, 1999 (in press).

Perkins CI, Allen ME, Wright WE, Takahashi E, Stoodt G, Cohen MS. Breast Cancer: Association between Stage at Diagnosis and MediCal Status in California. (Manuscript in preparation, 1999.)

Presentations:

Allen ME, Wright WE, Perkins CI. Estimation of Case Ascertainment by Linkage with Medicare Files. Presentation at the Annual Meeting of the North American Association of Central Cancer Registries. Minneapolis, MN, April 17, 1996.

Allen ME, Wright WE, Perkins CI. Stage at Diagnosis and Treatment among MediCal Breast Cancer Patients in California. Presentation at the Annual Meeting of the North American Association of Central Cancer Registries. Boston, MA, April 2, 1997.

Wright WE & Allen ME. California Cancer Registry: Enhancement for Breast Cancer Research. Poster presentation at the Department of Defense Breast Cancer Research Program Meeting. Washington, DC, November 1-4, 1997.

Takahashi E, Perkins C, Breen A, Wright W, Allen M. Costs of Treating Breast Cancer in the Medi-Cal (Medicaid) Population in California. Poster Presentation at the American Public Health Association Annual Meeting. Indianapolis, IN, November 9-13, 1997.

Perkins CI, Allen ME, Wright WE, Takahashi E, Al-Qazzaz S, Hiehle G. Breast Cancer Incidence in the California Medi-Cal Population. Presentation at the Annual Meeting of the California Association of Regional Cancer Registries. San Diego, CA, April 6, 1998.

O'Connor L, Prehn A, Topol B. Cancer treatment information collected from physicians' records. Presentation at the Annual Meeting of the North American Association of Central Cancer Registries Meeting. Vancouver, BC, April 22, 1998.

CONCLUSIONS

The usefulness of population-based cancer registries for research can be greatly enhanced with several modestly costing activities, namely extent of disease coding (EOD) at the time of initial data collection and linkages with external files that currently exist in every state and at the federal level (HCFA, DMV, hospital discharge). EOD coding will allow for greater communication between scientists and clinicians to the benefit of both. Linkages will improve follow-up for survival studies, and will allow for improved studies into medical care and economics. However, given that much breast cancer first course of treatment is administered in outpatient and physician office settings, cancer registries currently contain incomplete treatment information, and the costs to follow-up and collect that data are substantial. Until this problem is resolved, population-based research on treatment pattern differentials will continue to be severely compromised.

REFERENCES

1. National Institutes of Health. Summary Staging Guide – April 1997. U.S. Department of Health, Education, and Welfare, Public Health Service, Bethesda, MD, 1977.
2. Shambaugh EM, Ries LG, Young JL, Kruse MA, Platz CE, Ryan RF, Weiss MA. SEER Extent of Disease, 1998 Codes and Coding Instructions, Second Edition. National Cancer Institute, National Institutes of Health, NIH Publication No. 92-2313, Bethesda, MD, 1992.
3. Beahrs OH, Henson DE, Hutter RVP, Kennedy BJ (Eds.). American Joint Committee on Cancer, Manual for Staging of Cancer – Fourth Edition. J.B. Lippincott, Philadelphia PA, 1992.
4. Schulman J, Richardson L, Sever L, Wolters C. Follow-Up and Treatment Issues in the National Breast and Cervical Cancer Early Detection Program (NBCCEDP): Treatment Assessment Component (Final Report, Contract No. 200-92-0534, Centers for Disease Control and Prevention). Baltimore MD: Battelle Corporation, 1999.
5. Allen ME, Wright WE, Perkins CI. Stage at Diagnosis and Treatment Among Medi-Cal Breast Cancer Patients in California. Presentation at the Annual Meeting of the North American Association of Central Cancer Registries. Boston, MA, April 2, 1997.
6. Takahashi E, Perkins C, Breen A, Wright W, Allen M. Costs of Treating Breast Cancer in the Medi-Cal (Medicaid) Population in California. Poster Presentation at the American Public Health Association Annual Meeting. Indianapolis, IN, November 9-13, 1997.
7. Perkins CI, Allen ME, Wright WE, Breast Cancer Incidence Rates in the California Medi-Cal Population. Presentation at the Annual Meeting of the California Association of Regional Cancer Registries. San Diego, CA, April 6, 1998.

8. Allen M, Perkins C, Wright WE. Using Medicare Administrative Files to Evaluate Case Ascertainment in a Central Cancer Registry. *J Reg Mgmt.* 1998; 25(1):13-16.

List of Persons Receiving Pay from this Research Effort:

Central

Mark Allen
Evelyn Shambaugh
Lynda Douglas
Deborah Finley

Region 1/8

A. Moore
D. Boyd
E. Prestosa
C. Grilley
L. O'Connor
C. Luckett
R. Leung
B. Topol
L. Shelton
M. Robinson
H. Sanderson
M. Koo
M. Doane
T. Bernal
M. Anderson
M. Hackbarth.
M. Oehuli
L. Hurley

Region 2

Nancy Dorrough

Region 3

Barbara Lind
Michelle Troja
Cheryl Tatum
Dee LeTendre
Marti Felter
Scott Riddle
Kathleen Davidson-Allen

Region 4

Ann Stallings
Marilynn Lang

Region 5

Rebecca Cassady
Nadine Dyke

Region 6

Marianne Schlecht
Mignon Dryden

Region 7/10

Cheryl Jeffries
Susan Koutsourous
Sara Leach
Kathleen Rowley
Regina Weber
Janet Withem-Ortiz
Teresa Wong
Phyllis Villaverde

Region 9

Carlos Arambula
Jeanne Bamattre
Danielle Bar-Or
Antonio Bautista
Angelina Binene
Cynthia Conant
Patricia Maxson
Amy Ngaw Zaw
Arthur Zaw
Judith Boone
Charlotte Allison
Ginger Chiu
Karen Kishi
Lynn Sribour

APPENDIX I

Morris CR, Cohen R, Schlag R, Wright WE. Increasing use of breast conserving surgery in California. *Am J Public Health*, 1999 (in press).

DEPARTMENT OF HEALTH SERVICES

714/744 P STREET
P.O. BOX 942732
SACRAMENTO, CA 94234-7320
(916) 327-4663



July 2, 1999

Editor-in-Chief
American Journal of Public Health
1015 15th Street, NW
Washington, DC 20005

Dear Editor:

It is our pleasure to submit the final version of manuscript #98/0737 entitled "Increasing Use of Breast-Conserving Surgery in California," which has been accepted for publication. All suggestions from both reviewers were incorporated into the text. As requested by Dr. Northridge, we have mailed one additional copy of the manuscript to the New York office of the Journal.

Sincerely,

Cyllene R. Morris, D.V.M., Ph.D.
Richard Cohen, M.A.
Robert Schlag, M.Sc.
William E. Wright

William E. Wright, Ph.D.

Increasing Use of Breast-Conserving Surgery in California

Cyllene R. Morris¹, D.V.M., Ph.D.; Richard Cohen¹, M.A.;

Robert Schlag², M.Sc.; William E. Wright², Ph.D.

¹ Public Health Institute, California Cancer Registry

² California Department of Health Services, Cancer Surveillance Section

All correspondence and reprint requests should be addressed to:

Cyllene R. Morris, D.V.M., Ph.D.
Cancer Surveillance Section
Department of Health Services
601 N. 7th St., MS 592
P.O.Box 942732
Sacramento, CA 94234-7320

Phone: (916) 327-4642

Fax: (916) 327-4657

e-mail: cyllene@ccr.ca.gov

Word counts:

Abstract: 101

Text: 1793

References: 625

Number of tables: 3

Key words:

breast cancer, breast-conserving surgery, race, ethnicity, education.

Increasing Use of Breast-Conserving Surgery in California

ABSTRACT

This study utilizes data from the California Cancer Registry to determine temporal trends of breast-conserving surgery (BCS) for the treatment of early stage breast cancer in California from 1988 through 1995. A monotonically increasing trend in BCS utilization was detected, adjusting for race/ethnicity, age at diagnosis, stage at diagnosis, and neighborhood education level. BCS utilization increased at similar rates for all race/ethnic groups. Adjusted odds ratios indicated that women (*i*) of older age, (*ii*) of Asian or Hispanic race/ethnicity, (*iii*) diagnosed at later stages, or (*iv*) residing in undereducated neighborhoods were less likely to be treated with BCS than their counterparts.

INTRODUCTION

Based on results of retrospective studies and randomized clinical trials since 1980, the 1990 National Institutes of Health Consensus Conference¹ recommended breast-conserving surgery (BCS) as an appropriate therapy for most women with stage I and II breast cancer. These recommendations were reaffirmed in 1995, after exclusion of questionable data from one of the key clinical trials on the surgical treatment of breast cancer.²

Temporal trends in BCS utilization have been described for different geographic areas of the United States.³⁻⁹ In recent years, steady increases in BCS utilization have been reported. For example, in the Detroit metropolitan area the proportion of women with localized breast cancer receiving BCS increased from 4% (from 1973 to 1977) to 39% (from 1988 to 1992).³ That study, however, included only white or black women and excluded other race/ethnic groups. A recent population-based study in Connecticut reported an annual increase of 14% to 19% in the rates of BCS for stage I and II breast cancers diagnosed from 1989 to 1994,⁴ but race/ethnicity was not included in the analysis.

The unique diversity of the California population allows for the assessment of potential differences in patterns of care for different race/ethnic groups. This study utilizes data from the California Cancer registry (CCR) and reports the temporal trends for BCS in the treatment of women diagnosed with early stage breast cancer in California from 1988 through 1995. Trends of BCS utilization are analyzed by age, stage at diagnosis, and education in immediate neighborhood for women of white,

black, Hispanic, and Asian/Pacific Islander (PI) race/ethnicity. Two main questions were addressed in this study: *(i)* was there an increasing trend for BCS utilization in California during the study period, and *(ii)* despite differences in BCS utilization by race/ethnicity, age, stage at diagnosis, and education in neighborhood, is there evidence that BCS utilization has increased at similar rates in all these groups?

METHODS

Study population

This study included 104,466 women with early stage breast cancer (first primary only, histologically confirmed stages 0, I, or II) diagnosed in California from 1988 through 1995 who underwent either a mastectomy or BCS during their first course of treatment. The CCR is considered to have complete statewide coverage, and details of its operation and its ten reporting regions have been published elsewhere.^{10, 11}

Definition of variables

SEER extent of disease codes were converted to the American Joint Committee on Cancer (AJCC) staging system.¹² Age at diagnosis was grouped to represent pre-menopausal (0-49 years), and post-menopausal women before (50-64 years), and after eligibility to Medicare (65 and older).

Race/ethnicity was grouped into four mutually exclusive categories of Hispanic, non-Hispanic white, non-Hispanic black, and non-Hispanic Asian/PI. Hispanic ethnicity was based on information on the medical record or death certificate, and on surname. Women with race coded as white, black, or unknown with a last name (or maiden name, when present) on the 1980 U.S. Census list of 12,497 Hispanic surnames were categorized as Hispanic. The use of surname was adopted to more accurately classify Hispanic ethnicity, which is usually underreported in medical records and death certificates.¹³

Block group data from the 1990 U.S. Census was used to represent the educational level of the patient's neighborhood. A woman was considered to live in an undereducated neighborhood if 25% or more of adults age 25 and older in that particular block group had not completed high school.

Statistical analysis

Logistic regression was used to model temporal trends of BCS utilization over mastectomy, as measured by odds ratios (OR) and respective 95% confidence intervals (CI). Unadjusted OR of BCS utilization were estimated by year of diagnosis, race/ethnicity (Asian/PI, black, or Hispanic, with white as referent), age at diagnosis (50-64 or 65 +, with 0-49 as referent), stage at diagnosis (I or II, with 0 as referent), and education level in the patient's neighborhood (undereducated, with educated as referent). Multivariate models were constructed to estimate OR of BCS utilization, adjusting for all study variables. Year of diagnosis was coded as a series of dummy variables representing comparisons between adjacent years.¹⁴ A monotonically increasing trend for BCS utilization was considered to occur if all coefficients for the year variables were positive and statistically significant.¹⁵ To test if temporal trends were similar for all age levels, year of diagnosis was entered into a model as a single continuous variable together with interaction terms using dummy variables for age. Similar models were used to test for interactions of year with race, with stage, and with education, adjusting for all other variables. These models tested whether the slopes of the trend lines for levels within a class were different from the slope for the reference level in that class (for example, whether the annual

trend for Asian/PI, black, and Hispanic women differed from the trend for white women).

RESULTS

Characteristics of the women included in the study are shown in Table 1. In 1988, 27.9% of women diagnosed with stage 0, I, or II breast cancer received BCS as part of their first course of treatment. In 1995, the percentage of women receiving BCS increased to 54.1% (p-value for trend < 0.001). After controlling for race/ethnicity, age, stage at diagnosis, and neighborhood education, logistic regression models with year of diagnosis coded as comparisons between adjacent years show evidence of a significant monotonically increasing trend for BCS utilization (Table 2).

The analysis detected a significant impact of neighborhood education on the surgical treatment received. Women living in undereducated areas (OR: 0.75) were less likely to receive BCS than those living in educated areas. Stage at diagnosis and age at diagnosis were also significant factors in the type of surgery received. Women diagnosed at earlier stages or in younger age groups were more likely to be treated with BCS. The adjusted OR of receiving BCS were 0.83 and 0.67, respectively, for women diagnosed between 50 to 64 years old and for those 65 years and older, compared with women younger than 50 years at diagnosis. Likewise, women diagnosed with stage I (OR: 0.65) or stage II breast cancer (OR: 0.28) were significantly less likely to receive BCS than women diagnosed with *in situ* tumors. Significant differences in the odds of BCS were also detected among the four race/ethnic groups, and these differences persisted after adjusting for the factors above. Both Hispanic (OR: 0.86) and Asian/PI (OR: 0.57) women were less likely to

be treated with BCS than white women. On the other hand, black women were the most likely to receive BCS during the study period (OR: 1.16).

Interaction terms between year of diagnosis (treated as a continuous variable) and race/ethnicity were subsequently added to the model to test whether the slopes for the three race groups significantly differed from the slope for white women. The addition of the interaction terms did not significantly improve the model (p-value = 0.56), and all three interaction term coefficients were non-significant (Table 3). Therefore, there was no evidence that temporal trends during the eight-year period differed by race/ethnicity. On the other hand, it appears that BCS utilization is increasing somewhat faster among women 50 years and older (p-values < 0.001 for the age and year interaction terms), and among women living in educated areas (p-value = 0.048). The increase in BCS use has also been slightly more pronounced for women diagnosed with stage I breast cancer (p-value = 0.028).

DISCUSSION

The increasing linear trend detected in this study is consistent with reports from other areas in the U.S.^{3, 4} The monotonic character of the trend suggests that in California, as in Connecticut,⁴ negative publicity surrounding one of the key clinical trials in the U.S. had little impact on the acceptance of BCS for early-stage breast cancer.

The impact of age and stage at diagnosis,^{3, 8, 16-18} as well as census-derived education level,^{8, 19, 20} on the choice of surgical treatment for breast cancer was also consistent with previous studies. As expected, age at diagnosis was a strong predictor of type of surgery received, with younger women being significantly more likely to receive BCS. Other studies on BCS utilization have used education level either in the census tract⁸ or zip code^{19, 20} of residence as measures of socioeconomic status. In this study, education level in the block group of residence was also associated with BCS utilization - women living in undereducated areas were significantly less likely to receive BCS than those living in educated areas.

Although the appropriate treatment for *in situ* carcinomas is still the subject of controversy, results from this study show that BCS has been widely utilized for treatment of *in situ* breast cancers in California. In fact, the odds of receiving BCS for women diagnosed with *in situ* tumors were 1.5 and 3.6 times higher than the odds for women diagnosed with stage I or stage II breast cancer, respectively.

Findings from previous studies on the association between type of surgery and race/ethnicity have not been consistent. In one of these studies, white or black

women were equally likely to be treated with BCS, after adjusting for socioeconomic status and urban/rural residence.¹⁹ Race was also not a significant predictor of BCS in a study adjusting for tumor size and comorbidities.²¹ In a contrasting study using Medicare data, black women were 20% less likely to receive BCS than women of all other races, after adjusting for nodal status and hospital characteristics.²² In the present study, the large number of cases and the diversity of the California population enabled us to delineate marked differences in surgical treatment among the race/ethnic groups examined. The odds of receiving BCS for Hispanic and Asian/PI women in California were substantially lower than the odds for white or black women. Consistent with a previous study using a sample of U. S. hospitals from 1981-1987,²³ the odds of BCS was 16% higher for black than for white women.

Despite all the differences highlighted above, BCS utilization in California is increasing steadily for all race/ethnicities, age groups, stages at diagnosis, and education levels examined in this study. The rate of increase in BCS utilization was slightly higher among women 50 years and older, among women diagnosed with stage I breast cancer, and among women living in more educated neighborhoods. Nevertheless, no significant differences in the trend of BCS utilization were detected by race/ethnicity.

Although most women with stage I and II breast cancer are good candidates for BCS, the optimal proportion of women treated with BCS remains unresolved. Clearly, many non-clinical decisions factor into the complex choice of surgical treatment. For many women, the fear of recurrence and the hardship of radiotherapy

may outweigh the benefits of breast conservation. Nonetheless, the increasing trend towards BCS utilization in California and in other parts of the country is an indication that this important advance in the treatment of breast cancer is progressively gaining acceptance.

ACKNOWLEDGMENT

This research was supported by funds from the California Breast Cancer Research Program of the University of California, Grant Number 1KB-0175.

REFERENCES

1. National Institutes of Health Consensus Conference. Treatment of early stage breast cancer. *JAMA* 1991; 265:391-395.
2. Abrams JS, Phillips PH, Friedman MA. Meeting highlights: a reappraisal of research results for the local treatment of early stage breast cancer. *J Natl Cancer Inst* 1995; 87:1837-1845.
3. Chuba PJ, Simon MS. Trends in primary surgical and radiation therapy for localized breast cancer in the Detroit Metropolitan area 1973-1992. *Int J Radiat Oncol Biol Phys* 1997; 38:103-7.
4. Polednak AP. Trends in breast-conserving surgery in Connecticut: no effect of negative publicity. *Conn Med* 1996; 60:527-30.
5. Nattinger AB, Hoffman RG, Shapiro R, Gottlieb MS, Goodwin JS. The effect of legislative requirements on the use of breast-conserving surgery. *N Engl J Med* 1996; 335:1035-40.
6. Nattinger AB, Gottlieb MS, Hoffman RG, Walker AP, Goodwin JS. Minimal increase in use of breast-conserving surgery from 1986 to 1990. *Med Care* 1996; 34:479-89.
7. Farrow DC, Hunt WC, Samet JM. Geographic variation in the treatment of localized breast cancer [see comments]. *N Engl J Med* 1992; 326:1097-101.
8. Lazovich DA, White E, Thomas DB, Moe RE. Underutilization of breast-conserving surgery and radiation therapy among women with stage I or II breast cancer [see comments]. *JAMA* 1991; 266:3433-8.
9. Swanson GM, Satariano ER, Satariano WA, Osuch JR. Trends in conserving treatment of invasive carcinoma of the breast in females. *Surg Gynecol Obstet* 1990; 171:465-71.

10. Morris C, Cohen R, Perkins C, et al. *Cancer in California, 1988-1996*. Sacramento, CA: California Department of Health Services, Cancer Surveillance Section, 1999.
11. *Cancer Reporting in California: Abstracting and Coding Procedures for Hospitals - California Cancer Reporting System Standards - Volume 1*. Sacramento, CA: California Department of Health Services, Cancer Surveillance Section, 1995.
12. Shambaugh EM, Weiss MA, Ries LG, et al. *SEER Program: Comparative Staging Guide for Cancer*. Bethesda, MD: National Cancer Institute, 1993.
13. Stewart S, Glaser S, Horn-Ross P, West D. SEER study of methods to classify Hispanic cancer patients. Union City, CA: Northern California Cancer Center, 1993.
14. Walter SD, Feinstein AR, Wells CK. Coding ordinal independent variables in multiple regression analyses. *Am J Epidemiol* 1987; 125:319-323.
15. Maclure M, Greenland S. Tests for trend and dose response: misinterpretations and alternatives. *Am J Epidemiol* 1992; 135:96-104.
16. Lazovich D, White E, Thomas DB, Moe RE, Taplin S. Change in the use of breast-conserving surgery in western Washington after the 1990 NIH Consensus Development Conference. *Arch Surg* 1997; 132:418-23.
17. Kotwall CA, Covington DL, Rutledge R, Churchill MP, Meyer AA. Patient, hospital, and surgeon factors associated with breast conservation surgery. A statewide analysis in North Carolina. *Ann Surg* 1996; 224:419-26; discussion 426-9.
18. Nicolucci A, Mainini F, Penna A, et al. The influence of patient characteristics on the appropriateness of surgical treatment for breast cancer patients. *Progetto Oncologia Femminile. Ann Oncol* 1993; 4:133-40.
19. Michalski TA, Nattinger AB. The influence of black race and socioeconomic status on the use of breast-conserving surgery for Medicare beneficiaries. *Cancer* 1997; 79:314-9.

20. Albain KS, Green SR, Lichter AS, et al. Influence of patient characteristics, socioeconomic factors, geography, and systemic risk on the use of breast-sparing treatment in women enrolled in adjuvant breast cancer studies: an analysis of two intergroup trials. *J Clin Oncol* 1996; 14:3009-17.

21. Muss HB, Hunter CP, Wesley M, et al. Treatment plans for black and white women with stage II node-positive breast cancer. The National Cancer Institute Black/White Cancer Survival Study experience. *Cancer* 1992; 70:2460-7.

22. Nattinger AB, Gottlieb MS, Veum J, Yahnke D, Goodwin JS. Geographic variation in the use of breast-conserving treatment for breast cancer [see comments]. *N Engl J Med* 1992; 326:1102-7.

23. Johantgen ME, Coffey RM, Harris DR, Levy H, Clinton JJ. Treating early-stage breast cancer: hospital characteristics associated with breast-conserving surgery. *Am J Public Health* 1995; 85:1432-4.

Table 1. Characteristics of the study population and breast-conserving surgery (BCS) as percent of all surgical treatment: California, 1988-95

Characteristics	N (%)	BCS (%) ^a
All cases ^b	104,466 (100)	41.7
Race/Ethnicity		
White	83,895 (80.3)	42.7
Black	5,221 (5.0)	43.3
Hispanic	9,685 (9.3)	37.1
Asian/PI	5,665 (5.4)	32.5
Age at diagnosis		
0-49	23,995 (23.0)	45.0
50-64	31,619 (30.3)	43.0
65 +	48,852 (46.8)	39.2
Education in Neighborhood ^c		
Educated	76,474 (73.2)	44.0
Undereducated	27,992 (26.8)	35.4
AJCC stage at diagnosis ^d		
0	6,710 (6.4)	61.5
I	53,912 (51.6)	49.0
II	43,844 (42.0)	29.7
Year of Diagnosis		
1988	11,618 (11.1)	27.9
1989	11,543 (11.1)	30.3
1990	12,338 (11.8)	34.7
1991	13,007 (12.5)	37.9
1992	13,727 (13.1)	43.1
1993	13,592 (13.0)	48.1
1994	14,009 (13.4)	51.8
1995	14,632 (14.0)	54.1

- ^a BCS includes partial or segmental mastectomy, quadrantectomy, tylectomy, wedge resection, nipple resection, lumpectomy, or excisional biopsy, with or without dissection of axillary lymph nodes.
- ^b Cases reported only through autopsy or death certificate were excluded from the analysis. Also excluded were women who presented with any of the following conditions: microscopic tumor foci, mammography/xerography diagnosis only with no tumor size given, diffuse tumors, or inflammatory carcinoma.
- ^c Neighborhood education level based on the percent of adults 25 years and older without a high school diploma (undereducated = $\geq 25\%$, educated = $< 25\%$).
- ^d Stage 0: *in situ* tumors; stage I: tumors ≤ 2 cm without lymph node involvement; stage II: (i) tumors ≤ 2 cm with positive lymph nodes or (ii) tumors 2.1 cm to 4 cm, regardless of nodal status. Tumors larger than 4 cm (upper limit in most clinical trials) were excluded from the analysis.

Table 2. Adjusted and unadjusted odds ratios (OR) and 95% confidence intervals (CI) for temporal trends and factors associated with BCS ^a utilization

Factor	Unadjusted OR (CI)	Adjusted OR (CI) ^b
Race/Ethnicity		
White	1	1
Black	1.02 (0.97-1.08)	1.16 (1.09-1.23)
Hispanic	0.79 (0.76-0.83)	0.86 (0.82-0.90)
Asian/PI	0.64 (0.61-0.68)	0.57 (0.54-0.61)
Age at Diagnosis		
0-49	1	1
50-64	0.92 (0.89-0.95)	0.83 (0.80-0.86)
65 +	0.79 (0.76-0.81)	0.67 (0.65-0.69)
Education in Neighborhood ^c		
Educated	1	1
Undereducated	0.70 (0.68-0.72)	0.75 (0.73-0.77)
Stage at Diagnosis ^d		
0 (In situ)	1	1
I	0.60 (0.57-0.63)	0.65 (0.62-0.68)
II	0.26 (0.25-0.28)	0.28 (0.26-0.29)
Year of Diagnosis		
1988	1	1
1989 (compared with 1988)	1.13 (1.06-1.19)	1.12 (1.06-1.19)
1990 (compared with 1989)	1.22 (1.16-1.29)	1.21 (1.14-1.28)
1991 (compared with 1990)	1.15 (1.09-1.21)	1.13 (1.08-1.20)
1992 (compared with 1991)	1.24 (1.18-1.30)	1.25 (1.19-1.31)
1993 (compared with 1992)	1.22 (1.17-1.28)	1.23 (1.17-1.29)
1994 (compared with 1993)	1.16 (1.11-1.22)	1.16 (1.10-1.21)
1995 (compared with 1994)	1.10 (1.05-1.15)	1.12 (1.07-1.17)

- ^a BCS includes partial or segmental mastectomy, quadrantectomy, tylectomy, wedge resection, nipple resection, lumpectomy, or excisional biopsy, with or without dissection of axillary lymph nodes.
- ^b Odds ratios adjusted to all other variables in the model.
- ^c Neighborhood education level based on the percent of adults 25 years and older without a high school diploma (undereducated = $\geq 25\%$, educated = $< 25\%$).
- ^d Stage 0: *in situ* tumors; stage I: tumors ≤ 2 cm without lymph node involvement; stage II: (i) tumors ≤ 2 cm with positive lymph nodes or (ii) tumors 2.1 cm to 4 cm, regardless of nodal status. Tumors larger than 4 cm (upper limit in most clinical trials) were excluded from the analysis.

Table 3. Differences in temporal trends of BCS ^a by race/ethnicity, stage at diagnosis, age at diagnosis and neighborhood education

Model ^b	Slope (log-odds) of linear trend ^c	P-value for Slope ^d	Interaction P-value ^e
Race/Ethnicity			0.562
White (referent)	0.169	< 0.001	
Black	0.160	0.520	
Hispanic	0.175	0.578	
Asian/PI	0.153	0.264	
Age at Diagnosis			< 0.001
0-49 (referent)	0.142	< 0.001	
50-64	0.176	< 0.001	
65 +	0.176	< 0.001	
Education in Neighborhood ^f			0.048
Educated (referent)	0.172	< 0.001	
Undereducated	0.158	0.048	
Stage at Diagnosis ^g			0.003
0 (referent)	0.150	< 0.001	
I	0.177	0.028	
II	0.159	0.498	

^a BCS includes partial or segmental mastectomy, quadrantectomy, tylectomy, wedge resection, nipple resection, lumpectomy, or excisional biopsy, with or without dissection of axillary lymph nodes.

^b Each model was adjusted for all other variables.

^c Slope of time trend in log-odds of BCS utilization.

^d P-value for reference category tests difference of slope from zero. P-values for other categories test difference from reference category slope.

- ^e P-value for global test of interaction tests differences in time trends among groups.
- ^f Neighborhood education level based on the percent of adults 25 years and older without a high school diploma (undereducated = $\geq 25\%$, educated = $< 25\%$).
- ^g Stage 0: *in situ* tumors; stage I: tumors ≤ 2 cm without lymph node involvement; stage II: (i) tumors ≤ 2 cm with positive lymph nodes or (ii) tumors 2.1 cm to 4 cm, regardless of nodal status. Tumors larger than 4 cm (upper size limit in most clinical trials) were excluded from the analysis.